REMARKS

Claims 1-25 remain pending in the present application. Applicants greatly appreciate the thorough review of the present application and the indication of allowable subject in dependent claim 23. Claims 1, 11, 14, 15, 22 and 25 have been amended to more clearly claims the distinguishing features of the present invention and to improve the form of the claims. Also, claim 23 has been rewritten in independent form to include all of the limitations of its base claim 15 so that it is now in condition for allowance. Accordingly, reconsideration and allowance of the claims in the present application as amended are earnestly solicited in view of the following remarks.

Formal drawings will be submitted upon allowance of the present application.

Claims 1-25 stand rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,898,179 to Smick et al. This rejection is respectfully traversed.

Claims 1, 11, 14, 15 and 25 are directed to methods and apparatus for determining a direction or parallelism of a beam. The claims have been amended to recite that the beam is formed and implanted onto a work piece. An adjusted intensity profile from at least a portion of the beam is formed and variations in intensity of the adjusted intensity profile are detected downstream of the beam. Thereafter, the direction or parallelism of the beam is determined while the beam is implanting into the work piece. By measuring the direction and/or parallelism of the beam in-situ, the measurement and control of the beam direction and parallelism is performed more quickly and easily.

Smick et al. is directed to an apparatus for providing semiconductor work pieces with a pre-selected orientation relative to a treatment beam. In particular, an implantation control system is shown in Figs. 5 and 7. Two movable Faraday assemblies, a downstream Faraday 16 and an upstream Faraday 72 are positioned in the beam path at identical x-positions but with different z-positions. Phase angle difference between measurements of the beam position at the upstream and downstream Faradays 16 and 72 are used to calculate the deviation from parallel of the beam when the work piece is moved out of the beam path.

In contrast to Smick et al., the methods and apparatus claimed in the present application perform determinations of both direction and parallelism of the beam in-situ. The apparatus of Smick et al. requires that the work piece be moved out of the beam path and therefore cannot be performed while implanting the beam into the work piece as claimed in the present application.

Furthermore, the phase angle difference measurements of beam position between the upstream and downstream Faradays in Smick et al. only disclose performing parallelism calculations and do not disclose direction calculations. Accordingly, it is respectfully submitted that Smick et al. fail to disclose the determination of beam direction and/or parallelism while the beam is implanted into the work piece as recited in claims 1-25 of the present application.

In view of these amendments and for all of the above stated reasons, it is respectfully submitted that all of the outstanding objections and rejections have been overcome. Therefore, it is requested that claims 1-25 of the present application be passed to issue.

If any issues remain unresolved, the Examiner is requested to telephone the undersigned attorney.

Please charge any additional fees or credit any overpayments to deposit account No. 50-0896.

Respectfully submitted,
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MARKED-UP CLAIMS

1. (~~Twice~~ Thrice Amended) A method for determining a direction or parallelism of a beam, comprising:

forming a beam which is implanted into a work piece;

forming an adjusted intensity profile from at least a portion of the beam at a first position;

detecting at least one variation in intensity in the adjusted intensity profile downstream of the first position; and

determining a direction or parallelism of the beam while implanting into said work piece relative to a reference direction in response to detecting a distance in at least one dimension between a position where the at least one variation in intensity is detected and the first position where the adjusted intensity profile is formed.

11. (Twice Amended) A method for determining a direction or parallelism of an ion beam, comprising:

forming an ion beam which is implanted into a work piece;

blocking a portion of the beam with a beam modifier;

identifying a position where a shadow is formed separate from and downstream of the beam modifier; and

determining a direction or parallelism of the ion beam while implanting into said work piece in response to detecting a distance between the position of the shadow and the position of the beam modifier.

14. (~~Twice~~ Thrice Amended) An apparatus for determining a direction or parallelism of a beam, comprising:

means for forming a beam which is implanted into a work piece;

means for forming an adjusted intensity profile from at least a portion of the beam at a first position;

means for detecting an intensity profile of at least a portion of the beam downstream of the first position at a second position that is variable in distance from the first position in accordance with changes in direction or parallelism of the beam relative to a reference direction; and

means for determining a direction or parallelism of the beam relative to a reference direction while implanting into said work piece in response to detecting a distance between a position of the detected intensity profile and a position where the adjusted intensity profile is formed.

15. (~~Twice~~ Thrice Amended) An apparatus for determining a direction or parallelism of a charged particle beam, comprising:

at least one detector that detects an intensity profile of at least a portion of the charge particle beam which is implanted into a work piece;

a beam modifier that alters an intensity profile of at least a portion of the charged particle beam upstream of the at least one detector; and

a controller that determines a direction or parallelism of the charge particle beam relative to a reference direction while implanting into said work piece in response to a detected distance in at least one dimension between a position where the intensity profile is detected by the at least one detector and a position where the beam modifier created the detected intensity profile.

21. (Amended) A ion beam implantation apparatus comprising:

a charged particle beam generator that generates a charged particle beams; ~~and~~

~~the apparatus of claim 15~~

at least one detector that detects an intensity profile of at least a portion of the charge particle beam which is implanted into a work piece;

a beam modifier that alters an intensity profile of at least a portion of the charged particle beam upstream of the at least one detector; and

a controller that determines a direction or parallelism of the charge particle beam relative to a reference direction while implanting into said work piece in response to a detected distance in at least one dimension between a position where the intensity profile is detected by the at least one detector and a position where the beam modifier created the detected intensity profile.

23. (Amended) ~~The~~ An apparatus ~~of claim 15,~~ for determining a direction or parallelism of a charged particle beam, comprising:

at least one detector that detects an intensity profile of at least a portion of the charge particle beam which is implanted into a work piece;

a beam modifier that alters an intensity profile of at least a portion of the charged particle beam upstream of the at least one detector; and

a controller that determines a direction or parallelism of the charge particle beam relative to a reference direction while implanting into said work piece in response to a detected distance in at least one dimension between a position where the intensity profile is detected by the at least one detector and a position where the beam modifier created the detected intensity profile;

wherein the at least one detector includes at least three detectors and the controller determines a direction or parallelism of the charged particle beam in three dimensions relative to the reference direction.

25. (Amended) A method for determining a direction or parallelism of a beam, comprising:

forming a beam which is implanted into a work piece;

at a first beamline location, modifying the beam to produce a modified intensity profile having a spatial intensity variation;

at a second beamline location downstream of the first beamline location, detecting the spatial intensity variation in the modified intensity profile; and

determining a beam direction or parallelism while implanting into said work piece based on relative positions of the spatial intensity variation in the modified intensity profile at the first and second beamline locations.